



NOTES ABOUT ANTS AND THEIR RESEMBLANCE TO MAN

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Dr. Wheeler is the author of an unusually entertaining book, "Ants, Their Structure, Development, and Behavior," published by the Columbia University Press. The volume contains 650 pages and several hundred illustrations, and is probably the most scholarly and suggestive work on the subject that has been published. The pictures illustrating this article are from the above book.

IT IS sometimes profitable to turn away from the consideration of the social and economic problems, which so constantly beset us, to a study of the social insects and their methods of solving the problems which they, too, have had to face during their long and strenuous evolution.

Though in most respects man and the insect differ enormously, both nevertheless display some remarkable convergent similarities. They are the only two successful and dominant animal types of the present age, and, so far as they are social, not only have had to encounter the same obstacles, but have learned to overcome many of them in the same manner.

The social insects, however, have been more successful than man in organizing stable communities, because they have frankly trusted and followed their instincts and have therefore carried their social organization to its logical, or perhaps we had better say instinctive, conclusion, whereas man's intellectual processes and the ideals and dissensions to which they give birth forever prevent a definitive solution of economic problems

and keep him in a state of active and ceaseless evolution.

We naturally find, therefore, that the stable and well-regulated insect societies, which have "neither guide, overseer, nor ruler," have always aroused the admiration of those who long for a rigid communistic control of human society, while the individualist turns away from them with a feeling akin to horror.

THREE GREAT PROBLEMS OF EXISTENCE

It is well known that three great problems must be solved by every organism that would survive in the struggle for existence; first, how to obtain a sufficient quantity of the right kind of food; second, how to reproduce its kind and bring up its offspring, and, third, how to protect itself and its offspring from the injurious effects of both the lifeless and the living environment. And although all animals are constantly impelled to the solution of these problems by the primal instincts of hunger, love, and fear, the solution is often extremely difficult. And it is especially difficult in the social and colonial animals, because these must en-

Another subfamily, the Dorylinae, embracing the wonderful driver ants of Africa and the legionary ants of the American tropics, are also highly carnivorous, but nevertheless succeed in forming immense colonies, often of hundreds of thousands of individuals. This they accomplish by relinquishing the sedentary habits so characteristic of the great majority of ants. They keep moving in long files through the jungles, capturing or killing all the insects they encounter, and even overrunning dwellings, and, in their search for cockroaches and other vermin, driving out the human inhabitants. From time to time these strange ants bivouac for the night or for a few days in some hole in the ground, or under a tree, but soon continue their predatory march. Evidently they are able to remain carnivorous, and at the same time to develop large colonies, only because they are nomadic and can thus draw their food supply from a large area.

The Ponerinae and Dorylinae ants have thus adopted the only modes of life which will permit a union of predatism and sociability.

Their colonies must either remain small and rare, or, if populous, must keep moving from place to place. As each of these conditions has serious disadvantages, we find that the majority of ants have preferred to become more and more vegetarian, though, like man, usually without completely abandoning their carnivorous appetites.

A FAVORITE FOOD

One of the earliest departures from an exclusively animal diet is seen among the ants which attend plant-lice, scale insects, and leaf-hoppers and feed on their saccharine excrement. This excrement is, of course, merely plant sap slightly altered in its chemical constitution by passing through the digestive tract of the insects, and containing much water, some sugar, and a little nitrogenous matter.

Many ants are so inordinately fond of this food that they not only acquire an intimate acquaintance with the habits of the adult plant-lice and scale insects, but actually collect and store their eggs in

the nests during winter in order that they may during the ensuing spring distribute the hatching young over the roots or foliage of the plants. This is a well-developed habit among the species of *Lasius* throughout temperate North America and Eurasia (see pictures, pages 743, 744).

Other plant juices, such as the nectar of flowers and the similar liquid secreted by the glands on the petioles of leaves and by green galls, are also assiduously collected by ants. There is, moreover, a singular tendency for some ants which are engaged in this collection of nectar and plant-lice excrement to become "honey-ants" through an extraordinary exaggeration of the instinct to store liquid food in the crop or social stomach.

LIVING STOREHOUSES FOR FOOD

Certain individuals, the "repletes," of the colony refrain from leaving the nest and foraging for food and become converted into flagons by distending the crop to such enormous dimensions that the abdomen looks like a transparent bead (see pictures, pages 747, 748). In this condition they hang by their claws from the roof of the nest chamber and thenceforth spend all their lives receiving liquid food from the tongues of the foraging ants, storing it in their crops, and regurgitating it to hungry individuals when the liquid food supply outside the nest becomes inadequate. This is, of course, apt to be the case periodically in dry regions, so that we find the true honey-ants only in deserts like those of the southwestern states, northern Mexico, South Africa, and central Australia.

In such localities also a further adaptation to vegetarianism may be frequently observed in many species of ants which take to harvesting and eating the seeds of the small herbaceous plants. This harvesting habit is evidently a last resort in regions where insect food is very scarce or confined to a brief season.

There are several dozen species of harvesting ants in North America alone, the most conspicuous being those of the genus *Pogonomyrmex*, the species of which range all the way from Montana to the Argentine through the dry western portions of two continents. It was for-

ters of small, glistening food-bodies called "ambrosia" (see pictures, pages 750-754).

Some of the small Attii, instead of building their fungus-gardens on the floors, suspend them from the ceiling of the chambers, so that the masses of substratum clothed with fungus filaments hang down like white velvet curtains. This habit is beautifully developed in several species of *Trachymyrmex* and *Mycetosoritis*. One of these, *Trachymyrmex septentrionalis*, ranges as far north as the pine-barrens of New Jersey.

None of the Attii or their larvæ, so far as known, can eat anything except the particular kind of fungus which they cultivate. To appreciate the advantages to which these completely vegetarian ants have attained in thus substituting an easily controllable and abundant food-supply for the scarce and precarious insect diet of their predatory ancestors, one must observe these wonderful ants in Brazil or Central America, moving over their long trails in interminable processions, defoliating whole trees and carrying their leafy burdens like banners to their huge nest craters, which often spread over a quarter of an acre or more.

The foregoing remarks show that the ethnic history of ants parallels that of man to the extent that these insects were originally flesh-eating hunters, then shepherds of food-producing herds, and finally agriculturists, and that they have been compelled to pass through these stages or forfeit the advantages of living in populous and stationary communities. It is evident, furthermore, that the social needs of ants, like those of man, have been even more exigent than hunger.

SOCIAL DIETITIANS

The skill and success with which the higher ants have thus adapted their diet to the requirements of sociability contrasts markedly with the conditions in the other social insects. The social wasps are carnivorous, to be sure, but their colonies are small and rare like those of the Ponerinæ, and in temperate regions merely annual growths. The social bees have retained the exclusively vegetarian diet of their solitary ancestors, but, as they have greatly specialized by restrict-

ing this diet to nectar and pollen, they have become dangerously dependent on the evanescent flowers. And though they have learned to construct a wonderful system of cells for food storage, they are quite unable to control the food supply. Finally, the termites, though completely vegetarian, have also become too specialized by restricting their diet to wood, or cellulose, a hard and innutritious substance, which, though abundant, can be assimilated only with great difficulty.

It is significant, therefore, that the termites of Africa and the Indomalayan region, which form the largest and most aggressive colonies, have become fungus-growers. But even these have not yet learned, like the Attine ants, to grow "ambrosia" for all the members of the colony. The working population of the nests still has to live on wood in order to produce the excrement which is used in the construction of the gardens. The fungus itself is fed only to the young and to the sexual individuals.

It is a biological axiom that all organisms tend to propagate so rapidly that they are continually in danger of outrunning their food supply. This danger is even greater in the social or colonial than in the solitary organism, because the former is necessarily much hampered in its movements, and if every individual of which the colony consists be permitted to reproduce the food supply would very soon become so inadequate as seriously to impair the functions of the community as a whole. Hence it is not surprising that all social or colonial organisms are bound to restrict the reproductive function of their component individuals. This is true even of the individual organism itself regarded as a colony of cells.

REGULATING THE GROWTH OF FAMILIES

The four groups of social insects have, therefore, had to face a very difficult problem, and it is interesting to note that they have solved it in essentially the same manner as other social aggregates, the cell-aggregate, or individual organism included, namely, by restricting the reproductive function to a very few of the component individuals and by reducing

BORN WITH A WELL-STOCKED LARDER

To the former class belongs the queen of the fungus-growing ants, which not only leaves the maternal nest with the mental and bodily endowment of the ordinary queen, but also inherits some property in the form of a bundle of fungus filaments from the gardens of the maternal nest, tucked away in the little pocket in the floor of her mouth. After she has excavated her chamber in the soil and closed its entrance, she is thus in a position not only to bring up a first brood without extraneous aid, but to start the gardens with the fungus pellet, which she spits out, and keeps growing by careful weeding and by manuring it from time to time with her excrement, or even with her own broken eggs, till the first-ling workers hatch and begin to bring in the leaf material or caterpillar excrement, which is henceforth used as the only substratum for the gardens.

Very different is the endowment of the queens of a number of parasitic ants. These queens are either very small and feeble or lack the instincts and initiative that would enable them to found a colony independently. They are therefore compelled to seek assistance in this arduous task, and they succeed in securing it in one of the three following ways:

The young queens of some parasitic ants enter the colonies of an allied species, the workers of which then either kill their own queen and adopt the parasite in her stead or permit the latter to kill their queen. After the reproductive center of the host colony has been thus destroyed, the intrusive queen lays her eggs and permits her young to be brought up by the alien workers. These die off in the course of a few years, but by that time they have reared at least one brood of the parasitic species and the colony, now consisting exclusively of the queen and workers of this species, is sufficiently vigorous to lead an independent existence. This method of colony formation, in which the queen is relieved from the difficult task of feeding and rearing a first brood, has been called temporary social parasitism. It is characteristic of many of the largest and most

prosperous ants of the north temperate zone—e. g., of the mound-building ant of the Alleghanies (*Formica exsectoides*) and the fallow ant of Europe (*F. rufa*).

THE KIDNAPPERS

A different method is adopted by the slave-making ant *Formica sanguinea* and many of its subspecies (see picture, page 755). The young queen enters a nest of the common black *Formica fusca* or of some one of its many varieties, kills or drives away any of the workers when, irritated by her odor, they rush forth to attack her, then hastily collects a lot of the worker pupæ of the *fusca* and stands guard over and defends them till they hatch. These workers at once affiliate themselves with the queen as intimately as if she were their own mother and bring up her brood for her as soon as it appears.

The *sanguinea* young inherit their mother's peculiar instinct to attack the *fusca* colonies in the neighborhood and to kidnap the worker pupæ. They bring these pupæ back to the maternal nest and eat some of them, but permit others to hatch and become "auxiliaries," or "slaves." Thus what has been called slavery among ants is merely a form of parasitism, in which the "slave" species is really the host. In old colonies the *sanguinea* workers often lose the slave-making habit, and as the *fusca* workers then completely die out, there ensues an emancipation of the *sanguinea* colony from the host like that observed in the temporary social parasites.

THE SLAVERS

A third method is adopted by the young queens of the permanent social parasites. These queens enter the colonies of an alien species and are adopted like the queens of the temporary social parasites, after the enforced death of the host queen, but the worker offspring of the parasite are destined always to live with the host species. There are really two methods of insuring this result. One is by slavery, as in the case of the amazon ants (*Polyergus*), the workers of which are unable to feed themselves, to care for